OCR A-Level Chemistry A

Redox and electrode potentials mark scheme · goes with “Redox and electrode potentials” · whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/

Mark schemes

Redox and electrode potentials · 9 questions

Q1 · June 2019 · Paper 1 (Periodic table, elements and physical chemistry) · Q15 · [1 mark]

Answer: **C**

Only 2 and 3

Q2 · June 2022 · Paper 3 (Unified chemistry) · Q2 · [13 marks]

OCR MARK SCHEME

2(a)(i)

FIRST CHECK ANSWER ON THE ANSWER LINE

If answer = 2.19 × 10^{-3} award 3 marks

$n(Cl_2) = \frac{420}{24} = 17.5$ (mol) ✓

$n(Ca(ClO)_2) = \frac{17.5}{2} = 8.75$ (mol) ✓

Concentration $Ca(ClO)_2 = \frac{8.75}{4 \times 1000}$

$= 2.19 \times 10^{-3}$ (mol dm^{-3}) ✓

3SF AND standard form

[3 marks]

EXAMINER GUIDANCE

Use of ideal gas equation for all 3 marks provided ‘sensible’ *p* and *T* used:

e.g.

from 101 kPa and 298 K

→ *n* = 17.122 → 2.14 × 10^{-3}

from 100 kPa and 298 K

→ *n* = 16.952 → 2.12 × 10^{-3}

Examples of ‘sensible’

p = 100 kPa, 101 kPa, 101,325 Pa

T = 273 – 298 K

ALLOW ECF

Common errors

4.38 × 10^{-3} (no ÷ 2) → 2 marks

2.19 × 10^{n} → 2 marks

4.38 × 10^{n} → 1 mark

2.2 × 10^{-3} → 2 marks

not appropriate SF

2(a)(ii)

Equation

$3Ca(ClO)_2 \rightarrow 2CaCl_2 + Ca(ClO_3)_2$ ✓

Reduction

ALLOW *multiples*

ALLOW $3ClO^- \rightarrow 2Cl^- + ClO_3^-$

Cl reduced from +1 to –1 ✓

Oxidation

Cl oxidised from +1 to +5 ✓

+1 starting oxidation number seen once

Cl required for both explanation marks

IGNORE *oxidation numbers shown below/above equation (treat as rough working)*

BUT

If no oxidation numbers in explanation, look at equation for oxidation numbers

[3 marks]

ALLOW *1 out of 2 redox marks if oxidation number changes are BOTH correct ...BUT reduction/oxidation is incorrectly assigned, i.e.*

Cl is oxidised from +1 to –1

Cl is reduced from +1 to +5

ALLOW *1 out of 2 redox marks if oxidation changes correct but red and ox not stated*

Cl changes from +1 to –1

Cl changes from +1 to +5

General:

ALLOW number before sign in ox no, e.g. *1– for –1*

IGNORE *ionic charges, e.g.* Cl^{5+}

IGNORE *'1' (signs required)*

IGNORE *references to electron loss/gain (even if wrong)*

2(b)

6 marking points → 5 MAX

ALLOW *labels 1, 2 and 3; A, B and C, etc, provided that meaning is clear*

ALLOW *reverse argument (**ORA**) throughout*

For equations, **ALLOW** multiples

In equations, **ALLOW** ⇌ for →

Oxidising agent AND equation

$Cr_2O_7^{2-}$ is oxidising agent with C_2H_5OH /oxidises C_2H_5OH ✓

$Cr_2O_7^{2-} + 8H^+ + 3C_2H_5OH \rightarrow 2Cr^{3+} + 7H_2O + 3CH_3CHO$ ✓

Explanation for $Cr_2O_7^{2-}/Cr^{3+}$ and CH_3CHO/C_2H_5OH

E for $Cr_2O_7^{2-}/Cr^{3+}$ is more +ve /higher /greater

ALLOW $Cr_2O_7^{2-}$ *is oxidising agent if linked to* C_2H_5OH *as reactant in equation*

ALLOW Cr^{6+} *for* $Cr_2O_7^{2-}$

ALLOW $Cr_2O_7^{2-}$ *is reduced by* C_2H_5OH

In explanation,

look for CONs between '**OR**' statements

OR

E_{cell} = (+)1.527 V *+ sign not required*

OR

$Cr_2O_7^{2-}/Cr^{3+}$ equilibrium shifts right ✓

Reducing agent AND equation

Cr^{3+} is reducing agent with FeO_4^{2-} /reduces FeO_4^{2-} ✓

$2Cr^{3+} + 2H^+ + 2FeO_4^{2-} \rightarrow Cr_2O_7^{2-} + H_2O + 2Fe^{3+}$ ✓

ALLOW Cr^{3+} *is reducing agent if clearly linked to* FeO_4^{2-} *as reactant in equation*

ALLOW Fe^{6+} *for* FeO_4^{2-}

ALLOW Cr^{3+} *is oxidised by* FeO_4^{2-}

In explanation,

Explanation for $Cr_2O_7^{2-}/Cr^{3+}$ and FeO_4^{2-}/Fe^{3+}

E for $Cr_2O_7^{2-}/Cr^{3+}$ is less +ve (*E*) / lower /smaller

OR

E_{cell} = (+)0.87 V *+ sign not required*

OR

$Cr_2O_7^{2-}/Cr^{3+}$ equilibrium shifts left ✓

[5 marks]

look for CONs between '**OR**' statements

Note on equations

There are 2 marks for the equations with H^+, H_2O and e^- cancelled down

ALLOW *1 mark for 2 'correct' equations where H^+, H_2O and e^- have **NOT** all been cancelled down.*

e.g. 1 mark from 2 uncancelled equations

$Cr_2O_7^{2-} + 14H^+ + 3C_2H_5OH \rightarrow 2Cr^{3+} + 6H^+ + 7H_2O + 3CH_3CHO$

$2Cr^{3+} + 2H^+ + 2FeO_4^{2-} + 6e^- \rightarrow Cr_2O_7^{2-} + H_2O + 2Fe^{3+} + 6e^-$

2(c)

$5H_2S + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 5S + 8H_2O$

OR

$40\ H_2S + 16MnO_4^- + 48\ H^+ \rightarrow 16Mn^{2+} + 5S_8 + 64\ H_2O$

Any FIVE correct species ✓

Correct balanced equation ✓

[2 marks]

ALLOW *multiples*

e.g.

$2½\ H_2S + MnO_4^- + 3H^+ \rightarrow Mn^{2+} + 2½\ S + 4H_2O$

$20H_2S + 8MnO_4^- + 24\ H^+ \rightarrow 8Mn^{2+} + 2½\ S_8 + 32\ H_2O$

IGNORE *extra species containing: Mn, H, S and O ONLY*

BUT ALLOW $KMnO_4$ on LHS, forming K^+ on RHS

IGNORE *electrons*

IGNORE *state symbols*

Q3 · June 2023 · Paper 1 (Periodic table, elements and physical chemistry) · Q12 · [1 mark]

Answer: **C**

The overall cell reaction is: $Li + CoO_2 \rightarrow LiCoO_2$

Q4 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q10 · [1 mark]

Answer: **C**

$½O_2(g) + H_2O(l) + 2e^- \rightarrow 2OH^-(aq)$

Q5 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q11 · [1 mark]

Answer: **B**

Mg(s)

Q6 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q20 · [9 marks]

OCR MARK SCHEME

20(a)(i)

Circuit: complete circuit **AND** voltmeter

AND labelled salt bridge linking two half-cells ✓

Half cells Pt **AND** V^{2+} **AND** V^{3+} ✓

Zn **AND** Zn^{2+} ✓

Standard conditions:

1 mol dm^{-3} seen anywhere in response

AND 298 K / 25°C ✓

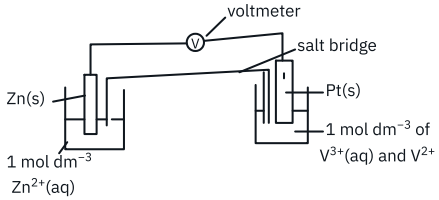
[4 marks]

EXAMINER GUIDANCE

Electrodes / salt bridge must at least touch the surface

ALLOW *small gaps in circuit wires*

ALLOW *half cells drawn either way around*



ALLOW *1 M*

IGNORE *Equimolar for half cell 4*

IGNORE *1 mol / dm^3*

IGNORE *pressure*

DO NOT ALLOW *1 mol(e) for concentration*

20(a)(ii)

(+)0.5(0) V ✓

[1 mark]

$E^{\ominus}_{cell}$ = −0.26 − (−0.76) = +0.5

DO NOT ALLOW *−0.5V*

20(b)

Equations

$Co + 2VO^{2+} + 4H^{+} \rightarrow Co^{2+} + 2V^{3+} + 2H_2O$ ✓

$Co + 2V^{3+} \rightarrow Co^{2+} + 2V^{2+}$ ✓

Comparison of *E* values

(*E* of) Co / system 3 is more negative/less positive than (*E* of) VO^{2+} / system 5

AND (*E* of) Co / system 3 is more negative/less positive than (*E* of) V^{3+} / system 4 ✓

Equilibrium shift related to *E* values (3/5 OR 3/4)

More negative/less positive (Co) / system 3 shifts left

ALLOW *multiples*

ALLOW ⇌

ALLOW *CO as Co*

IGNORE *state symbols even if wrong*

IGNORE *higher / lower electrode potential*

IGNORE *use of < / > for E comparison*

ALLOW *E_{cell} is (+)0.62V for Co / VO^{2+} cell*

AND E_{cell} is (+)0.02V for Co / V^{3+} cell

AND

Less negative/more positive VO^{2+} / system 5 shifts right

OR Less negative/more positive V^{3+} / system 4 shifts right ✓

[4 marks]

ALLOW *both half equations with <u>one</u> headed arrow (→) for each half equation in correct direction for systems 3/5* ***OR*** *systems 3/4*

e.g. $2H^+ + VO^{2+} + e^- \rightarrow V^{3+} + H_2O$

AND

$Co \rightarrow Co^{2+} + 2e^-$

IGNORE *working on the table, treat as rough working*

Q7 · June 2025 · Paper 3 (Unified chemistry) · Q5 · [16 marks]

OCR MARK SCHEME

5(a)(i)

phenylmethanol ✓

[1 mark]

EXAMINER GUIDANCE

ALLOW *1-phenylmethanol, Phenylmethan-1-ol, 1-phenylmethan-1-ol*

DO NOT ALLOW

Hydroxymethylbenzene **OR** methylphenol

5(a)(ii)

FIRST CHECK THE ANSWER ON ANSWER LINE

If mass $LiAlH_4$ = 4.96 OR 4.97 g

AND % yield = 77.6 OR 77.5 (%) award 4 marks

Percentage yield 3 marks

Theoretical moles

$n(C_6H_5COOC_2H_5)$ **OR** $n(C_6H_5CH_2OH)$

$= \frac{7.50 \times 1.05}{150.0}$ **OR** 0.0525 (mol) ✓

Actual moles

$n(C_6H_5CH_2OH) = \frac{4.40}{108.0}$ **OR** 0.0407.... (mol) ✓

Calculator = 0.04074074074

% yield

$\%\ \text{yield} = \frac{0.0407....}{0.0525} \times 100 = 77.6\%$ (3 sig fig) ✓

ALLOW *77.5 – 77.6 %*

taking into account rounding to 0.0407

ALLOW ECF *for each step*

NOTE*: 7.50 × 1.05 = 7.875 g*

Alternative method using mass

1. Theoretical moles = 0.0525 mol
2. Mass = 0.0525 × 108.0 **OR** 5.67 g
3. % yield = $\frac{4.40}{5.67} \times 100 = 77.6\%$

Common errors

No density: $\frac{7.50}{150.0} = 0.0500$ mol ✗

- % yield = 81.4 – 81.5% ✓✓ **ECF**
- $LiAlH_4$ mass = 4.74 g ✓ **ECF**

÷ density: $\frac{7.50/1.05}{150.0} = 0.0476..$ ✗

- % yield = 85.5 – 85.6 % ✓✓ **ECF**
- $LiAlH_4$ mass = 4.46 g ✓ **ECF**

Mass of $LiAlH_4$ 1 mark

mass $LiAlH_4$ = 0.0525 × 2.5 × 37.9 = 4.97 ..... g ✓

Calculator = 4.974375 g

3SF

ALLOW *4.96 – 4.97 g*

3 SF

taking into account rounding to 0.131

[4 marks]

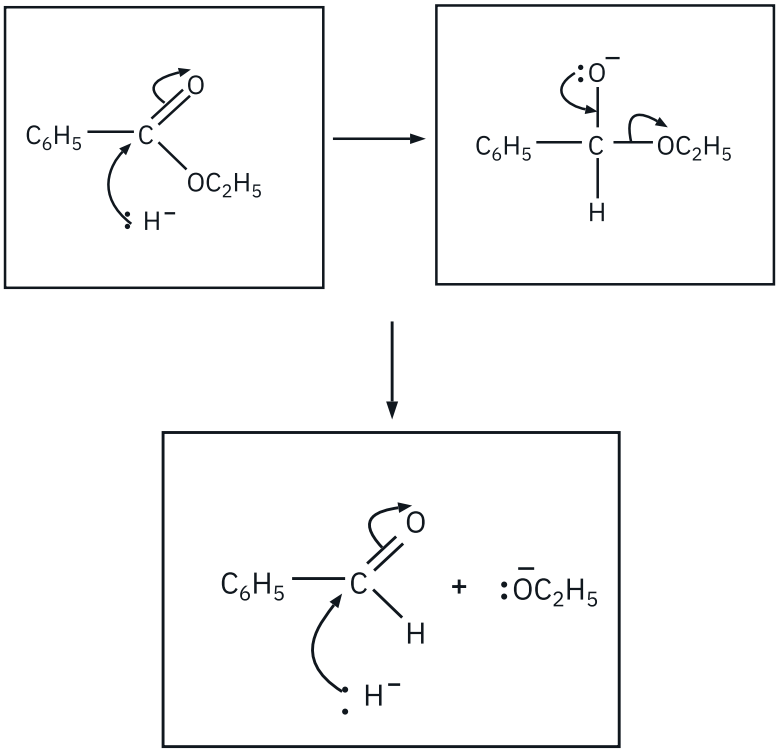
5(a)(iii)

Donates an electron pair (to another species) ✓

ALLOW *donates a lone pair*

[1 mark]

5(a)(iv)



6 curly arrows correct ✓✓✓✓

5 curly arrows correct ✓✓✓

4 curly arrows correct ✓✓

3 curly arrows correct ✓

Annotate incorrect or absent curly arrows first with x or ^

Helps to account for marks.

IGNORE *any added charges* ***OR*** *dipoles.*

Marks solely for curly arrows

For each mark, an extra curly arrow is a CON

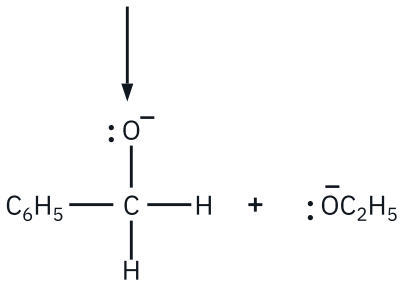
ALLOW *curly arrow from :*

OR from – charge on O^- or H^-

Curly arrow from a bond MUST go to O in C=O and in $–OC_2H_5$

IGNORE *any curly arrows on bottom structures (not in boxes):*

i.e.



[4 marks]

5(a)(v)

ALLOW $O^- + H^+ \rightarrow OH$

H^+ adds to –ve ion/anion/O^-

OR

–ve ions are protonated

OR

Protonates the product (from Step 2)

OR

Provides H^+ to form the alcohol ✓

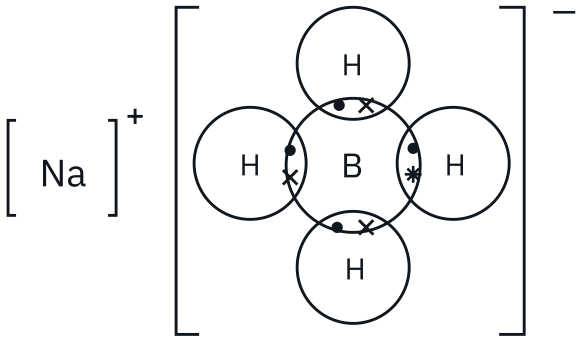
Needs idea of H^+ being gained/donated

IGNORE *'to form an OH group/alcohol*

Must include idea of H^+ involved.

[1 mark]

5(b)



8 electrons around B

AND 4 covalent bonds between B and 4 H atoms

AND Na with no electrons **OR** 8 electrons ✓

3 covalent bonds containing x or o **AND**

1 covalent bond containing x **OR** o **AND** extra Na electron shown differently **AND** charges ✓

ALLOW *dot and cross labels swapped:*

i.e. • for B electrons and × for H electrons

NOT REQUIRED

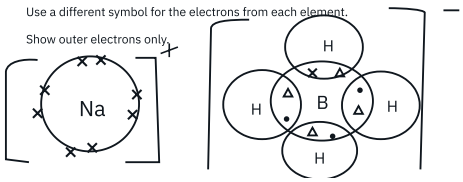
- Brackets
- Circles
- B and H symbols

IGNORE *inner shells*

DO NOT ALLOW ANY *marks for a covalent* $NaBH_4$

IF *8 electrons around Na, the 'extra' electron around B must match Na electrons*

ALLOW *other symbols than x and o provided that the origin of the electron is clear, e.g.*



[2 marks]

5(c)(i)

–1.24 V ✓

– sign required

[1 mark]

5(c)(ii)

$NaBH_4 + OH^-$ on left-hand side

AND $NaBO_2 + H_2O$ on right-hand side ✓

Correct balanced equation with electrons ✓

$NaBH_4 + 8OH^- \rightarrow NaBO_2 + 6H_2O + 8e^-$

ALLOW: $Na^+ + BH_4^-$ and Na^+ and BO_2^-

IGNORE *O_2 for the 1st mark only*

ALLOW *multiples*

IGNORE *state symbols*

ALLOW 1 mark for 'correct equation' but wrong way *round,*

i.e. $NaBO_2 + 6H_2O + 8e^- \rightarrow NaBH_4 + 8OH^-$

[2 marks]

For 2nd mark, any common species on both sides of equation needs to be cancelled

Q8 · November 2020 · Paper 1 (Periodic table, elements and physical chemistry) · Q12 · [1 mark]

Answer: **C**

1 : 1

Q9 · November 2021 · Paper 1 (Periodic table, elements and physical chemistry) · Q12 · [1 mark]

Answer: **C**

$Cu^{2+}(aq)$

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